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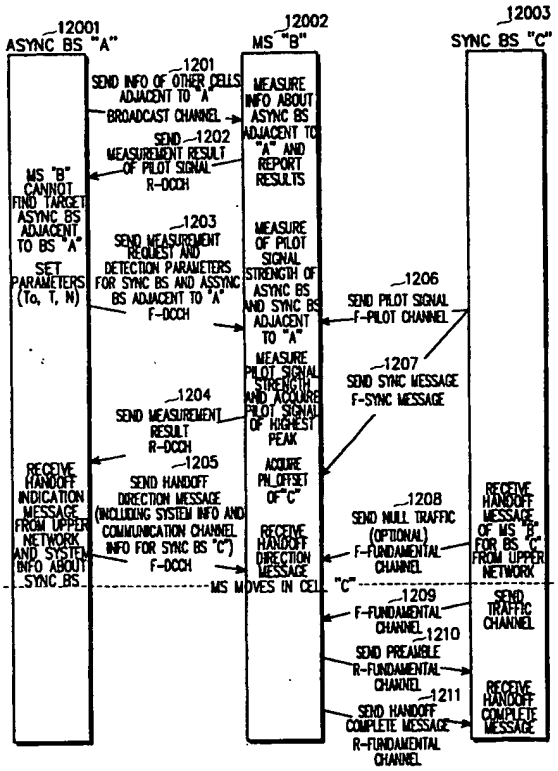

(57) Abstract: The method for implementing a handoff, in which a mobile station travels from a present cell of an async base station to a cell of a sync base station, includes the steps of: the mobile station's receiving a pseudo-noise (PN) offset signal from the sync base station for a predetermined time, the PN offset signal indicating a specific PN offset value of the sync base station; the mobile station's reporting the PN offset value to the async base station; the mobile station's receiving system information about the sync base station from the async base station; and the mobile station's performing the handoff to the cell of the sync base station based on the received system information.

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APPARATUS AND METHOD FOR IMPLEMENTING HANDOFF IN MOBILE COMMNICATION SYSTEM WITH SHORT SYNC CHANNEL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to an apparatus and method for implementing handoff in a mobile communication system, and more particularly, to a novel apparatus and method for implementing handoff when a mobile station travels from a cell of the async mobile communication system to a cell of the sync mobile communication system.

2. Description of the Related Art

The async mobile communication system may be, for example, UMTS adopted as the European standards and the sync mobile communication system may be IMT-2000 adopted as the American standards. These two systems are becoming increasingly harmonized and there is thus a need for various technologies that are compatible with both systems. One of such technologies is related to handoff that may happen between the sync mobile communication system and the async mobile communication system.

The handoff is a technology that enables users to continuously receive a call service without interruption when a mobile station travels from a present cell to an adjacent cell during the call service in a mobile communication system. The handoff is classified into soft hand off and hard hand off. In the soft hand off, the mobile station maintains a call using both a channel assigned by a target base station and a channel assigned by the present base station in service. Eventually, the mobile station abandons one of the two channels, whose quality has a value lower than a threshold of the pilot strength. In the hard hand off, a channel assigned by the present base station in service is first released and then, connection to an adjacent base station is attempted.

Until now, development of the handoff has been concentrated on the sync mobile communication system. But, with the emergence of the async mobile communication system, research has been undertaken regarding handoff between

sync and async mobile communication systems.

The mobile station usually acquires information about adjacent cells and informs the base station of the information when a pilot signal received from one of the adjacent cells has strength higher than a threshold or requested by the base station. The information sent to the base station is used as information about the handoff performed when the mobile station travels from a present cell to the adjacent cell during a call service. The base station transmits the information about the handoff through a paging channel (for the sync communication system) or a broadcasting channel (for the async communication system). A hard handoff takes place normally when the mobile station travels from a cell of the async mobile communication system to a cell of the sync mobile communication system. For the hard handoff, the mobile station interrupts a call service from the async mobile communication system while it acquires information about the adjacent cells.

Conventionally, the mobile station has to perform the following procedure in order to interpret information about the sync mobile communication system. First, the mobile station interprets a sync signal message stored in the sync signal frame transferred from the sync channel of the sync mobile communication system. The transmission bit per 80 ms frame of the sync signal frame is 96 bits, and the sync signal message, including information the mobile station can communicate with the sync mobile communication system, has a length of 221 bits. Thus the mobile station needs at least 240 ms (80 ms $\times$ 3) for interpreting the message. The above-mentioned specifications are included in the TIA/EIA-IS-2000.5 standards that define the sync mobile communication system.

Hereinafter, a base station of the sync mobile communication system will be referred to as "sync base station" and a base station of the async mobile communication system will be called "async base station".

Fig. 3 illustrates a procedure for the mobile station in communication with a present async base station to acquire information about the adjacent sync base stations. Referring to Fig. 3, the mobile station receives from an async base station a information search message about sync base stations adjacent to the async base station, in step 301. Then, the mobile station sets to detect information about the adjacent sync base stations in step 303, and detects pilot signals from the adjacent sync base stations in step 305. The mobile station determines in step

307 whether a pilot signal having a highest peak value is detected. Upon failure to detect such a pilot signal of highest peak value, the mobile station returns to step 305. If a highest peak value of a pilot signal is detected, the mobile station proceeds to step 309 to receive sync frames through the forward sync channel of the sync base station from which the pilot signal having the highest peak value has been detected. In this case, the mobile station has to receive at least three sync frames from the sync base station in order to receive all sync signal messages. For example, the mobile station takes at least 240 ms in receiving the sync frames from the sync base station having a channel structure shown in Fig. 2 and, during the frame reception time, interrupts the communication with the async base station. Taking a long time in performing the procedure of Fig. 3 may therefore result in a detrimental effect such as a loss of data communicated between the async base station and the mobile station.

Conventionally, the forward channel of the sync base station has a structure of Fig. 2. Referring to Fig. 2, the forward channel includes a forward pilot channel 203 generating a pilot signal, a forward sync channel 204 generating a sync signal, a forward dedicated control channel 202 generating a dedicated channel control message, a forward dedicated fundamental channel 207 generating a voice signal, and a forward dedicated supplemental channel 208 generating packet data. The construction and operation of the individual channels are disclosed in detail, for example, in P1998-11381 previously issued by the inventor.

Fig. 11 illustrates a handoff procedure according to prior art when the mobile station travels from a cell of the async base station to a cell of the sync base station shown in Fig. 2.

Referring to Fig. 11, in step 1101, mobile station B receives from async base station A a message including information about another base stations adjacent to the async base station A through a broadcast channel (in the async communication system) or a paging channel (in the sync communication system). In step 1102, the mobile station measures the reception strengths of pilot signals transferred from the adjacent base stations and sends a message including the measurement results of the pilot signals to the async base station A through a reverse dedicated channel. Then, the async base station A analyzes the message on the reverse dedicated channel to determine whether there is a target async base station. If a target async base station exists, the async base station A confirms the

handoff; otherwise, it sets parameters T, T_0 and N for detecting the reception strength of the pilot signals from the adjacent sync base stations, where T_0 is a time to detect the pilot signal of a sync base station, T is a time interval for detecting the pilot signal of the sync base station, and N is a parameter defining the number of times for detecting the pilot signal of the sync base station. In step 1103, the mobile station B receives a direction message on a forward dedicated control channel to measure the reception strength of the pilot signals of the async and sync base stations adjacent to the async base station A, and a message including the parameters. Upon receiving forward dedicated control channel message, the mobile station B measures the reception strengths of the pilot signals from the sync and async base stations adjacent to the async base station A based on the parameters T, T_0 and N.

In step 1106, the mobile station B detects a pilot signal received from the individual sync base stations adjacent to the async base station A. Here, the pilot signal enables the mobile station B to estimate the channels and rapidly acquire initial synchronization for new multiple paths. Besides detection of the pilot signal, the mobile station B analyzes in step 1107 a sync message received from a sync base station such as sync base station C through a forward sync channel to recognize the sync base station C, and acquires system information about the sync base station C. The sync message includes system information necessary for communication with the sync base station C, such as system ID number, network ID number, PN_OFFSET value, long code information 320msdlgndml, and paging channel data rate. For example, the sync channel frame used in the IS-95 system is 80 ms in length with a data rate of 96 bits and comprises three sub frames having a length as long as one period of a short code. Here, the sync message including the system information about the sync base station C has a length of more than 200 bits including a message length field and CRC(Cyclic Redundancy Check). Even when the message is less than 96 bits in length, the 80ms sync frame necessarily sends 96 bits by adding the surplus bits to the message. Thus the mobile station B must receive at least three 80ms sync frames in order to receive all sync messages including the system information. Without errors in the sync messages, it takes at least 240 ms for the mobile station B to recognize the sync base station C and receive information of the sync base station C.

In step 1104, the mobile station B sends a message, including the measurement results of the reception strength of the pilot signals received from

the adjacent base stations and information about the sync message, to the async base station A through a reverse dedicated channel. Then, the async base station A analyzes the received message on the reverse dedicated channel and sends the measurement results to the upper network. The upper network determines the target sync base station C refer to the measurement results and sends to the async base station A a handoff indication message including information necessary for the handoff. In step 1105, the mobile station B receives the handoff direction message including information about traffic channels for communication with the target sync base station C, through the forward dedicated channel from the async base station A. Once receiving the handoff direction message, the mobile station B prepares to receive traffic data from the sync base station C with reference to the traffic channel information included in the message. In step 1108, the mobile station B receives null traffic data or the like on a forward fundamental channel from the sync base station C to ensure stability of channels. The mobile station B receives in step 1109 a traffic message on the forward fundamental channel from the sync base station C while moving to a cell of the target sync base station C, thereby switching a call service from the async base station A to the sync base station C. Thereafter, the mobile station B sends a preamble on a reverse fundamental channel to inform that transmission is successful, in step 1110, and sends a handoff complete message on the reverse fundamental channel to the sync base station C, in step 1111.

With the above-described forward channel structure of the conventional sync mobile communication system, the mobile station B must receive at least three sync frames on the forward sync channel of the sync mobile communication system. For example, a sync mobile communication system having the channel structure shown in Fig. 2 has the minimum reception time of 240 ms. Thus it will take at least 240 ms for the mobile station B to acquire system information for communication with the sync base station C while traveling from a cell of the async base station A to a cell of the target sync base station C. During the reception time, the mobile station interrupts communication with the async base station A. That is, taking a long time in performing the procedure of Fig. 3 results in a detrimental effect such as a loss of data communicated between the async base station and the mobile station.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a base station

communication apparatus and method in a sync mobile communication system having a forward short sync channel that generates a pseudo-noise offset signal.

It is another object of the present invention to provide a channel transmission apparatus and method for generating a pseudo-noise offset signal in a sync system.

It is further another object of the present invention to provide a handoff apparatus and process that uses a forward short sync channel generating a pseudo-noise offset signal in a sync mobile communication system, when a mobile station travels from a cell of an async mobile communication system to a cell of the sync mobile communication system.

It is still further another object of the present invention to provide an apparatus and method for reducing a time required for a mobile station presently communicating with an async mobile communication system to receive information about a sync mobile communication system. The apparatus and method uses a forward short sync channel generating a PN_OFFSET signal in the sync mobile communication system.

To achieve the above objects, there is provided a method for implementing a handoff in which a mobile station travels from a present cell of an async base station to a cell of a sync base station. The method includes the steps of: the mobile station receiving a pseudo-noise (PN) offset signal from the sync base station for a predetermined time, the PN offset signal indicating a specific PN offset value of the sync base station; the mobile station reporting the PN offset value to the async base station; the mobile station receiving system information about the sync base station from the async base station; and the mobile station performing the handoff to the cell of the sync base station based on the received system information

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings in which:

Fig. 1 is a diagram illustrating the structure of a base station in a sync mobile communication system having a short sync channel in accordance with the

present invention;

Fig. 2 is a diagram illustrating a structure of a base station in the conventional sync mobile communication system;

Fig. 3 is a diagram illustrating a procedure for receiving information about a sync mobile communication system by a mobile station presently in communication with an async mobile communication system;

Fig. 4 is a diagram illustrating a detailed construction of a forward short sync channel generator shown in Fig. 1;

Fig. 5 is a diagram illustrating a structure of the short sync data fed into the short sync channel generator;

Fig. 6 is a diagram illustrating a repetitive transmission of a short sync frame within one cycle of a PN short code in the forward short sync channel;

Fig. 7 is a diagram illustrating a handoff procedure for an async base station according to the present invention;

Fig. 8 is a diagram illustrating a handoff procedure for a mobile station according to the present invention;

Fig. 9 is a diagram illustrating a handoff procedure for a sync base station according to the present invention;

Fig. 10 is a diagram that illustrates base station pilot signal detection parameters used in the async base station according to the present invention;

Fig. 11 is a diagram illustrating messages communicated while the mobile station hands off from an async base station to a sync base station according to prior art; and

Fig. 12 is a diagram illustrating messages communicated while the mobile station hands off from an async base station to a sync base station in a sync mobile communication system having a short sync channel in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Preferred embodiments of the present invention will be described below with reference to the accompanying drawings. In the following description, well-known functions or constructions are not described in detail since they would obscure the invention in unnecessary detail. Like reference numbers denote the same components in the drawings.

By way of example, the present invention is illustrated in terms of a length of frames transmitted on the respective channels, a coding rate, and the

number of data and symbols output from the blocks of the respective channels. It will be understood by those skilled in the art that the present invention is easily implemented with various changes in form and details.

The term "PN_OFFSET value" as used herein means a message transmitted on a short sync channel of a sync base station and the message transmitted on the short sync channel refers to the offset value of a pseudo noise code used in a sync mobile communication system.

Fig. 1 illustrates an exemplary construction of the respective channels communicated between in a mobile station and a base station, and a channel communication device for the respective channels in a code division multiple access (CDMA) communication system, which is one of the sync mobile communication systems in accordance with the embodiment of the present invention. The respective channels shown in Fig. 1 are illustrated focusing on a transmitter.

To describe the channel construction of a base station, a controller 101 controls(enables/disables) an operation of the individual channel generators, processes a message which transmitted and received in physical layer of base station and communicates messages with the upper layer. Pilot channel generator 103, sync channel generator 104, short sync channel generator 105 and paging channel generator 106 are devices for generating common channel information shared among the users in a single cell or a plurality of cells. Dedicated control channel generator 102, fundamental channel generator 107 and supplemental channel generator 108 are devices for generating dedicated channel information assigned differently to the users.

The dedicated control channel generator 102 processes various control messages received on a forward dedicated control channel (DCCH) and sends them to a mobile station. The messages on the forward dedicated control channel include radio link protocol (RLP) frames or various control messages (L3 signalling messages) used in the IS-95B and medium access control(MAC) messages related to a packet data service control, i.e., assigning or releasing supplemental channels. Power control signals can be transmitted on the dedicated control channel instead of the fundamental channel, in which case the power control signals are included in the control messages. On the forward dedicated control channel, the dedicated control channel generator 102 negotiates with the

base station in regard to a data rate to be used for a supplemental channel or, if orthogonal codes are used for the supplemental channel, gives a direction to change the orthogonal codes. The forward dedicated control channel is spread with one unused orthogonal code among those not assigned to the pilot channel generator 103, sync channel generator 104, short sync channel generator 105 or paging channel generator 106. The RLP frame provides a service for successful transmission of an octet stream. The RLP may be classified into transparent RLP and non-transparent RLP. The transparent RLP does not retransmit an erroneously transmitted frame but informs the upper layer of the time and position of the erroneously transmitted frame. The non-transparent RLP involves error correction.

The pilot channel generator 103 processes information received on a forward pilot channel and sends the received information to the mobile station. The forward pilot channel always transmits logic signals of all 0's or 1's. It is assumed herein that the pilot channel transmits logic signals of all 0's. The pilot channel signal enables the mobile station to rapidly acquire initial synchronization for new multiple paths and estimate channels. The pilot channel is spread with one specific orthogonal code previously assigned thereto.

The sync channel generator 104 processes information received on a forward sync channel and sends the received information to the mobile station. Information on the sync channel enables every mobile station in a cell to acquire initial time and frame synchronizations. The forward sync channel is spread with one specific Walsh code previously assigned thereto.

The short sync channel generator 105 processes information received on a short sync channel and sends the received information to the mobile station. Information on the short sync channel of length K bits provided mobile station in order to search for information about the sync base station in a short time. The information represented by the value can be a PN_OFFSET value of the sync base station and zero padding bits. As the mobile station acquires the information in a short time, the information is transmitted a predetermined number of times N_2 in a period of one PN short code. Examples of K and N_2 are presented in Figs. 5 and 6. The mobile station in communication with the async mobile communication system receives the information and sends it to the async base station within the period of one PN short code. The information thus transmitted enables the async base station to update information about its adjacent cells. The information is also used for a handoff that happens when the mobile station travels from a cell of the

async mobile communication system to a cell of the sync mobile communication system. Besides the above information, information concerning the sync base station transmitted on the sync channel is sent to the mobile station through a paging channel or a broadcasting channel by the async base station. Upon receiving the information on the short sync channel, the mobile station traveling to a cell of the sync base station gets in communication with the sync base station without a separate synchronization process because it already has the knowledge of the system information about the sync base station. The information on the short sync channel is spread with one specific Walsh code previously assigned to the short sync channel and equally used in every system.

The paging channel generator 106 processes information received on a forward paging channel and sends the received information to the mobile station. Information on the paging channel is all information necessary prior to establishment of traffic channels. The forward paging channel is spread with one of orthogonal codes previously assigned thereto.

The fundamental channel generator 107 processes information received on a forward fundamental channel and sends the received information to the mobile station. Information on the forward fundamental channel may include a variety of control messages (L3 signaling) used in the IS-95B and power control signals, other than the voice signal. If necessary, such information may include RLP frames and MAC messages. The fundamental channel has a data rate of 9.6 kbps or 14.4 kbps and, according to circumstances, has a variable data rate such as 4.8 kbps or 7.2 kbps as 1/2 of the given data rate; 2.4 kbps or 3.6 kbps as 1/4 of the data rate; or 1.2 kbps or 1.8 kbps as 1/8 of the data rate. Such a variable data rate must be detected by the receiving unit. The forward fundamental channel is spread with an orthogonal code not assigned to the pilot channel generator 103, sync channel generator 104, short sync channel generator 105, or paging channel generator 106.

The supplemental channel generator 108 processes information received on a forward supplemental channel and sends the received information to the mobile station. Information on the forward supplemental channel includes RLP frames, packet data and the like. The supplemental channel generator 108 has a data rate of more than 9.6 kbps. The supplemental channel generator 108 has a scheduled data rate, i.e., the base station communicates with the mobile station at a data rate determined under negotiation with the mobile station through the

dedicated control channel. The forward supplemental channel is spread with an orthogonal code not assigned to the pilot channel generator 103, sync channel generator 104, short sync channel generator 105 or paging channel generator 106. The fundamental channel and the supplemental channel become traffic channels.

An adder 109 adds in-phase channel transmission signals on the forward link from dedicated control channel generator 102, fundamental channel generator 107 and supplemental channel generator 108 to transmission signals from pilot channel generator 103, sync channel generator 104, short sync channel generator 105 and paging channel generator 106. An adder 110 adds together quadrature-phase channel transmission signals output from dedicated control channel generator 102, fundamental channel generator 107 and supplemental channel generator 108. A spread modulator 111 multiplies the transmission signals from the adders 109 and 110 by a spreading sequence and ascent frequency converts the transmission signals. A receiver 122 frequency converts the respective channel signals of the mobile station on the reverse link with a base band and then despreads the signals through multiplication of the converted signals by a spreading sequence. The constructions of the reverse link channel receivers provided in the base station are omitted in Fig. 1.

Now to describe the channel construction of the mobile station, a controller 113 enables/disables the operation of the individual channel generators, processes a message communicated by the mobile station, and communicates messages with the upper layer.

A dedicated control channel generator 114 processes various control messages received on a reverse dedicated control channel and sends them to a base station. The messages on the reverse dedicated control channel include radio link protocol (RLP) frames or various control messages used in the IS-95B, and medium access control messages (MAC) related to a packet data service control, i.e., assigning or releasing supplemental channels. For a reverse link, power control signals are not separately transmitted on the dedicated control channel because they are inserted in a pilot channel for transmission. On the reverse dedicated control channel, the dedicated control channel generator 114 negotiates with the base station in regard to a data rate to be used for a supplemental channel. The reverse dedicated control channel generator 114 spreads the individual channels with unique orthogonal codes previously assigned thereto to discriminate the channels and spreads the signals from the users with unique PN codes to

discriminate the users. Thus different orthogonal codes are assigned to a dedicated control channel, a pilot channel, an access channel, a fundamental channel and a supplemental channel in order to discriminate the respective channels and the respective orthogonal codes used for every channel are shared among the users. For example, an orthogonal code used for the dedicated control channel is shared among all users to discriminate the dedicated control channel.

The reverse dedicated control channel has a fixed data rate of 9.6 kbps, which prevents any performance deterioration in determining the data rate and eliminates a data rate determination circuit, reducing complexity of the receiver. Also, the reverse dedicated control channel has the same data rate as the basic data rate of voice signals, i.e., 9.6 kbps, thus maintaining the same service diameter as the basic voice service.

A pilot channel generator 115 processes information received on a reverse pilot channel and sends the received information to the base station. Like the forward pilot channel, the reverse pilot channel enables rapid acquisition of initial synchronization for new multiple paths and channel estimation. The reverse pilot channel also transmits reverse power control information by adding power control signals to the pilot signal at a defined time.

An access channel generator 116 processes information received on a reverse access channel and sends the received information to the base station. The information on the access channel includes control messages and all information about the mobile station required to the base station prior to establishment of a traffic channel.

A fundamental channel generator 117 processes information received on a reverse fundamental channel and sends the received information to the base station. Information on the reverse fundamental channel normally includes voice signals. Such information may include a variety of control messages (L3 signaling) used in the IS-95B as well as voice signals. If necessary, the information may include RLP frames and MAC messages. For a reverse link, power control signals are not separately transmitted on the access channel because they are inserted in the pilot channel for transmission. The fundamental channel has a fixed data rate of 9.6 kbps or 14.4 kbps and, according to circumstances, has a variable data rate such as 4.8 kbps or 7.2 kbps as 1/2 of the given data rate; 2.4 kbps or 3.6 kbps as 1/4 of the data rate; or 1.2 kbps or 1.8 kbps as 1/8 of the data

rate. Such a variable data rate must be detected by the receiving unit. The reverse fundamental channel generator 117 spreads the individual channels with unique orthogonal codes previously assigned thereto to discriminate the channels and spreads the signals from the users with unique PN codes to discriminate the users. Thus different orthogonal codes are assigned to a pilot channel, an access channel, a fundamental channel and a supplemental channel in order to discriminate the respective channels and the respective orthogonal codes used for every channel are shared among the users. For example, an orthogonal code used for the fundamental channel is shared among all users to discriminate the fundamental channel.

A supplemental channel generator 118 processes information received on a reverse supplemental channel and sends the received information to the base station. Information on the reverse supplemental channel includes RLP frames, packet data and the like. The supplemental channel generator 118 has a data rate of more than 9.6 kbps. The supplemental channel generator 118 has a scheduled data rate, i.e., the base station communicates with the mobile station at a data rate predetermined under negotiation with the mobile station through the dedicated control channel. The reverse supplemental channel spreads the individual channels with unique orthogonal codes previously assigned thereto to discriminate the channels and spreads the signals from the users with unique PN codes to discriminate the users. The fundamental channel and the supplemental channel will become traffic channels.

An adder 119 adds together transmission signals on the reverse link received from the dedicated control channel generator 114 and the pilot channel generator 115. An adder 120 adds together transmission signals on the reverse link received from access channel generator 116, fundamental channel generator 117 and supplemental channel generator 118. A spread modulator 121 multiplies the transmission signals from the adders 119 and 120 by a spreading sequence and ascent frequency converts the transmission signals. A receiver 112 frequency converts the respective channel signals of the mobile station on the reverse link with a base band and then despreads the signals through multiplication of the converted signals by a spreading sequence. The constructions of the reverse link channel receivers provided in the mobile station are omitted in Fig. 1.

In the CDMA communication system according to the embodiment of the present invention, as shown in Fig. 1, the base station comprises controller 101,

dedicated control channel generator 102, pilot channel generator 103, sync channel generator 104, short sync channel generator 105, paging channel generator 106, fundamental channel generator 107 and supplemental channel generator 108. And, the mobile station comprises controller 113, dedicated control channel generator 114, pilot channel generator 115, access channel generator 116, fundamental channel generator 117 and supplemental channel generator 118. For the output form of the individual channel generators in the base station, the signals from dedicated control channel generator 102, fundamental channel generator 107 and supplemental channel generator 108 are two channel signals, i.e., in-phase channel component and quadrature-phase channel component, while only one channel signal is generated from pilot channel generator 103, sync channel generator 104, short sync channel generator 105 and paging channel generator 106. It is assumed herein that the only one channel component is the in-phase channel component.

Unlike the channel generators of the base station, those of the mobile station generate only one channel component. Thus the outputs of the dedicated control channel generator 114 and the pilot channel generator 115 of the mobile station are added up and fed into the spread modulator 121 as an in-phase channel, and the outputs of the remaining channel generators 116, 117 and 118 are added up and fed into the spread modulator 121 as a quadrature-phase channel. When using the access channel, the output of the pilot channel generator 115 is an in-phase channel input and the output of the access channel generator 116 is a quadrature-phase channel input, since the access channel generator 116 generates the output prior to generation of the traffic channel.

The construction and operation of all channel transmitters except for the short sync channel transmitter shown in Fig. 1 are described in detail in Korean Patent No. 98-11381 issued by this inventor.

The following descriptions are first given to the detailed construction of the short sync channel transmitter and then to the procedure for performing a handoff from an async mobile communication system to a sync mobile communication system.

Fig. 4 is a detailed illustration of the short sync channel transmitter 105 in accordance with the embodiment of the present invention.

Referring to Fig. 4, an encoder 401 encodes input short sync channel data and outputs the coded short sync channel data. The short sync channel data can be a PN_OFFSET value and the encoder 401 can be a convolutional encoder or a turbo encoder. It is assumed in Fig. 4 that use is made of a convolutional encoder having a coding rate of 1/2 and a constraint length of 9. An interleaver 403 interleaves the symbols output from a repeater 402 in order to prevent burst errors. The interleaver 403 can be a block interleaver or a turbo interleaver. A signal converter 404 converts the level of the short sync channel signal output from the interleaver 403. A multiplier 405 multiplies the sync channel signal output from the signal converter 404 by an orthogonal code. The orthogonal code used at the multiplier 405 is a predetermined one of the Walsh codes. It should be noted that the Walsh code used at the multiplier 405 is the only one specified Walsh code shared among the users in the sync mobile communication system. The Walsh code used at the multiplier 405 has a length defined in the sync mobile communication system. For example, the Walsh code has a length of 128 in the IMT2000 SR1 environment and 256 in the IMT2000 SR3. The encoder 401, repeater 402 and interleaver 403 are not necessarily required but optionally given and their types are also optional. Information input to the short sync channel generator 105 can have various forms. For example, the input of the short sync channel generator 105 can be a PN_OFFSET value solely, or a PN_OFFSET value accompanied by CRC, or a separately coded PN_OFFSET value.

Fig. 5 illustrates the frame structure of information input to the short sync channel generator 105. Referring to Fig. 5, information 501 input into the short sync channel generator 105 is the PN_OFFSET value of the sync base station, where K bits express the PN_OFFSET value. In Fig. 5, the PN_OFFSET value and the zero padding bit are K bits and accompanied by the CRC(Cyclic Redundancy Check)502 in transmission. The current sync mobile communication system employs a PN_OFFSET value of 9. The length of the information frame input to the short sync channel generator 105, the data rate and the length of the CRC are variable depending on the length of the Walsh code, the number of repetitions and the type of the encoder.

Fig. 6 illustrates the structure of a short sync channel frame transmitted in a period of one PN short code (e.g, 26.6... ms). Referring to Fig. 6, the short sync channel frame is transmitted N_2 ($N_2 \geq 1$) times in the period of one PN short code. That is, several transmissions of the PN_OFFSET value are possible in a period of one PN short code. Thus the mobile station can acquire information about the

sync base station in a short time.

The number of transmissions N_2 for the short sync channel frame is calculated according to the following equation.

[Equation 1]

$$N_chip = \{(K + CRC) \times R \times N_1 \times W^1\} \times N_2$$

The variables used in the Equation 1 are defined as:

N_chip is the number of chips in a period of one PN short code (e.g., 32768 for SR1, or 98304 for SR3);

K is the data bit (PN_OFFSET value + length of zero padding bit);

CRC is the CRC bits used in the short sync channel;

R is the coding rate of the encoder used in the short sync channel generator;

N_1 is the number of symbol repetitions;

W^1 is the length of the Walsh code; and

N_2 is the number of transmissions for the PN_OFFSET frame in a period of one PN short code.

For example, assuming that the PN_OFFSET value = 9 bits, N_chip = 32768, R = 2, N_1 = 2 and W^1 = 128 in the current sync mobile communication system, the Equation 1 can be rewritten as 64 = (K+CRC) × N_2 and the bit rate of the short sync channel is 2400 bps. For two repetitions of the short sync channel frame, K+CRC must be 32 bits. If the CRC has 20 bits, K can be determined as 10 bits including 9 bits of the PN_OFFSET value plus 1 bit of the zero padding bit.

In another example, assuming that the PN_OFFSET value = 9 bits, N_chip = 32768, R = 2, N_1 = 2 and W^1 = 128 in the current sync mobile communication system, the Equation 1 can be rewritten as 64 = (K+CRC) × N_2 and the bit rate of the short sync channel is 2400 bps. For four repetitions of the short sync channel frame, K+CRC must be 16 bits. If the CRC has 4 bits, K can be determined as 12 bits including 9 bits of the PN_OFFSET value plus 3 bits of the zero padding bit.

Now, a description will be given for a procedure for performing a handoff from an async mobile communication system to a sync mobile communication

system in accordance with the embodiment of the present invention.

In the following description, a base station of the sync mobile communication system will be referred to as "sync base station" and a base station of the async mobile communication system will be called "async base station". The handoff between the async base station and the sync base station in Figs. 7 to 9 is a soft hand off. Also, the sync base station has the channel structure shown in Fig. 1.

Fig. 7 illustrates a handoff procedure for an async base station A in accordance with the embodiment of the present invention.

Referring to Fig. 7, async base station A receives the measurement results of the pilot signals of the adjacent async base stations from a mobile station B, in step 701. To search for a target async base station, the mobile station B measures the strengths of the pilot signals received from the async base stations adjacent to the async base station A and reports information about the async base station having a pilot signal higher than a threshold. Then, the async base station A determines in step 702 whether there exists a target for handoff async base station based on the measurement results received from the mobile station B. If it is determined that such an async base station exists, the async base station A sends to the mobile station B a handoff direction message including information necessary for handoff in step 703. Otherwise, the async base station A proceeds to step 704 to set parameters T, T_0 and N for detecting the pilot signals of the adjacent sync base stations. These parameters T, T_0 and N are illustrated in Fig. 10, in which T_0 is a time to detect the pilot signal of a sync base station, T a time interval for detecting the pilot signal of the sync base station, N a parameter defining the number of times for detecting the pilot signal of the sync base station.

In step 705, the async base station A sends to the mobile station B the parameters and a direction message to measure the strengths of the pilot signals of the async base station A and sync base stations adjacent to the async base station A. The mobile station B detects the pilot signals of the adjacent sync base stations for time period T_0. The mobile station B detects the pilot signal of the async base station adjacent to the async base station A while maintaining communication with the async base station A for time period of $T-T_0$. Thereafter, the async base station A receives the measurement results of the pilot signals from the mobile station B in step 706. The measurement results of the pilot signals are divided into

four types: (1) information about successful detection of another target async base station, (2) information about successful detection of the target sync base station, (3) information about successful detection of the target sync base station and another target async base station, and (4) information about failed detection of the target base station. The information about successful detection of a sync base station is transmitted together with the system information of the sync base station C. There are two types of system information of the sync base station C: the one is the PN_OFFSET value of the detected sync base station C having a short sync channel shown in Fig. 1; and the other is the sync message of the detected sync base station (Fig. 2) received on a sync channel.

Upon receiving the measurement results of the pilot signals from the mobile station B, the async base station A determines in step 707 whether there exists a target cell for handoff. If there is no target cell, the async base station A returns to step 701 to repeat the above procedures. Otherwise, when the target cell is detected, the async base station A determines in step 708 whether the target cell is an async base station or a sync base station. That is, the async base station A must determine in step 708 whether the target cell detected is a sync base station or an async base station, since the mobile station measures pilot signals of both async base station and sync base station in step 704 of determining the parameters. Once both the sync base station and the async base station are detected, the system parameters of the async base station A are used to determine which base station to hand off, and the system information of the async base station is used to determine which base station has the priority over the other. Once the target cell is determined as an async base station in step 708, the async base station A sends to the mobile station B a handoff direction message necessary for handoff to the determined async base station. Otherwise, when the target cell is determined as a sync base station, the async base station A sends to the upper network the pilot signal strength and the PN_OFFSET value or system information of the determined sync base station received from the mobile station B, in step 706.

Subsequently, in step 710, the async base station A receives from the upper network a handoff request message, requesting the mobile station to handoff to the sync mobile communication system. For handoff to the sync mobile communication system shown in Fig. 1, the async base station A further receives the system information about the sync base station. During the step 710, the upper network sends information indicating that the mobile station will be handed off to the target sync base station. The reception target of this information

can be the sync base station or its upper network. Upon receiving the handoff indication message from the upper network, the async base station A sends to the mobile station B a handoff direction message including information necessary for handoff to the sync base station determined.

In another embodiment, the sync base station A skips the step 704 and performs the step 707 immediately after the mobile station B travels to a cell of the async base station A. Thus this embodiment advantageously shortens a time required for the async base station to cause handoff of the mobile station.

Figs. 8A and 8B illustrate a handoff procedure for the mobile station being in communication with the async base station in accordance with the embodiment of the present invention, wherein the mobile station operates in a dual mode enabling communication with both the async base station and the sync base station.

Referring to Fig. 8A, the mobile station B measures the strengths of received pilot signals and sends the measurement results to the async base station A in step 801. Here, once the mobile station finds another target async base station, it sends a message indicating that another target async base station has been found; otherwise, it sends a message indicating that another target async base station has not been found. Thereafter, the mobile station B determines in step 802 whether a request message has been received from the async base station A that requests to measure the pilot signals of base stations adjacent to the async base station A. Upon receiving a handoff direction message to the target cell of an async base station (from the async base station A in step 703 of Fig. 7) in response to the message requesting measurement of the pilot signals, the mobile station B performs handoff to the cell of the async base station A in step 803 and sends a preamble signal on the reverse link to the target cell of the async base station in step 804. Subsequently, the mobile station B sends a handoff complete message to the target cell of the async base station in step 805.

Meanwhile, if the received message in step 802 is the message (sent in step 705 of Fig. 7) requesting measurement of the pilot signals, the mobile station B receives the parameters for determining the pilot signals of the async and sync base stations adjacent to the async base station A, in step 806. The parameters are defined in Fig. 10. It should be noted in determination of the parameters in step 806 that an excessively long time T_0 in detecting the pilot signal of the target sync

base station results in instability in communication with the async base station; that an excessively long time interval T causes difficulty in detecting the pilot signals of the sync base station; and that a large parameter N results in an extremely long time for detecting a target base station (i.e., a target sync base station or a target async base station) and causes the mobile station to miss the time to perform handoff, leading to interruption of the call service. Thus the parameters must be determined in consideration of these aspects.

For time period To, the mobile station B detects the pilot signal strength of the sync base station N times, T time interval from step 807 to step 813. For time period T-To, the mobile station B detects the pilot signal strength of the async base station adjacent to the ssync base station A. while maintaining communication with the asyn base station A, in step 810. The pilot signal of eh sync base station can be detected in step 808 by two method. The one method directly detects the sync signal for time period To. The other method involves setting the value of time period To as small as possible to secure stability of the communication between the async base station and the mobile station, storing the siganls transferred from the sync base station in a buffer, and detecting the pilot signal of the sync base station for time period T-To form the signals stored in the buffer in an offline way. Once the pilot signal of the sync base station is detected in step 808, the mobile station B interprets the system information of the sync base station from the message of the sync channel or short sync channel of sync base station in step 808, the mobile station interpretates the system information of the sync base station from the message of the sync channel or short sync channel of the sync base station from the message of the sync channel or short sync channel of the sync base station in step 809. If the first method is used to directly detect the pilot signal for time period To in step 809, the mobile station B must maintain the channel with the sync base station for a time period long enough to acquire the system information of the sync base station and does not return to the channel with the async base station. If using the second method to detect the pilot signal of the sync base station from the signals stored in the buffer in step 809, the mobile station must maintain the channel with the sync base station for a time period long enough to acquired the system information of the sync base station during a second time period To after To storing the pilot signal of the sync base station.

Meanwhile, if the sync base station has no short sync channel, the mobile station B must receive the sync message transferred on the sync channel of the

sync base station for at least 240 ms, in step 809. Thus the stability of the communication between the mobile station and the async base station may not be secured in order to acquire information necessary for handoff in the mobile communication system having no short sync channel. Otherwise, if the sync base station has a short sync channel as in the sync mobile communication system shown in Fig. 1, the mobile station B receives in step 809 the PN_OFFSET value of the sync base station transferred on the short sync channel within 26.6 ms. In step 810, if no pilot signal is detected in time T_0, the mobile station B detects the pilot signal strength of the async base stations adjacent to the async base station A and maintains communication with the async base station A for time period $T-T_0$. The mobile station B determines in step 811 whether the measured strength of the pilot signal of the individual async base stations has a value requiring handoff. If such a pilot signal is detected, the mobile station B proceeds to step 813 in FIG. 8B; otherwise, the mobile station B goes to step 812. Upon failure in detecting both the pilot signal of the potential sync base station and the pilot signal of the potential async base station in steps 808 and 810, the mobile station B determines in step 812 whether the number of repetitions exceeds N. If the number of repetitions does not exceed N and neither the pilot signal of the sync base station nor the pilot signal of the async base station has been detected, the mobile station B returns to step 807 to repeat steps 808 to 810. If the number of repetitions exceeds N, the mobile station B sends the measurement results obtained until that time to the async base station in step 812. The mobile station B goes to step 813 just after step 809 when the pilot signal is detected in step 808 with the number of repetitions not exceeding N. The mobile station B proceeds to step 813 immediately when the pilot signal is detected with the number of repetitions not exceeding N in step 810 and the detected pilot signal is determined to have an adequate strength for the target async base station in step 811.

After sending the measurement results of the pilot signal in step 813 of FIG. 8B, the mobile station B determines in step 814 whether a handoff direction message has been received from the async base station A. If the handoff direction message has been received, the mobile station B returns to step 802; otherwise, the mobile station B determines in step 815 whether the handoff direction message is a handoff message to a target sync base station or to a target async base station. When the handoff direction message received in step 814 is a handoff message to a target async base station, the mobile station B performs the steps 819 to 821, which are analogous to the steps 803 to 805 of Fig. 8A.

On the other hand, when the handoff direction message is determined as a handoff message to a target sync base station in step 815, the mobile station B goes to step 816 to perform a handoff using the system information of the target sync base station included in the received handoff direction message. That is, the mobile station B moves to the target sync base station to receive traffic data on the forward fundamental channel from the sync base station and sends a preamble on the reverse fundamental channel to the sync base station, in step 817. Then, the mobile station B sends a handoff complete message through the reverse fundamental channel to the sync base station, in step 818.

Fig. 9 illustrates a handoff procedure for the target sync base station in accordance with the embodiment of the present invention, in which it is assumed that the sync base station has the same channel structure as shown in Fig. 1.

Referring tc Fig. 9, the sync base station C sends a pilot signal on the pilot channel and its PN_OFFSET value on the short sync channel in step 901. The PN_OFFSET value of the sync base station C can be transmitted on the short sync channel as illustrated in Fig. 5, or in other various forms. The short sync channel generator can have a construction as shown in Fig. 4, in which the encoder, the interleaver and the repeater are optionally given. Information of the short sync channel is transmitted N_2 times in every 26.6ms. The sync base station C receives in step 902 the handoff message of the mobile station to the sync base station from the upper network. In step 903, the sync base station C sends null traffic channel data or the like on the forward fundamental channel to the mobile station B. This step 903 is optionally given. In step 904, the sync base station C sends the traffic channel with the forward fundamental channel to the mobile station B immediately after the mobile station B moves to a cell of the sync base station C. Then, the sync base station C receives in step 905 the handoff complete message from the mobile station B to end the handoff.

Fig. 12 illustrates a handoff procedure from a cell of the async base station A to a cell of the sync base station C in accordance with the embodiment of the present invention. In the following description, it is assumed that the sync base station has the same channel structure as shown in Fig. 1.

Referring to Fig. 12, in step 1201, mobile station B receives from the async base station A a message including information about another base stations adjacent to the async base station A through a broadcast channel or a paging

channel. In step 1202, the mobile station B measures the reception strength of pilot signals transferred from the adjacent base stations and sends a message including the measurement results of the pilot signals to the async base station A through a reverse dedicated channel. Then, the async base station A analyzes the message on the reverse dedicated channel to determine whether there is a target async base station. If a target async base station exists, the async base station A confirms the handoff; otherwise, it sets parameters T, T_0 and N for detecting the reception strength of the pilot signals from the adjacent sync base stations. In step 1203, the mobile station B receives a direction message on the forward dedicated control channel to measure the reception strength of the pilot signals of the sync and async base stations adjacent to the async base station A, and a message including the parameters. Here, T_0 is a time to detect the pilot signal of a sync base station, T a time interval for detecting the pilot signal of the sync base station, N a parameter defining the number of times for detecting the pilot signal of the sync base station. Upon receiving the message on the forward dedicated control channel, the mobile station B measures the reception strength of the pilot signals from the sync and async base stations adjacent to the async base station A based on the parameters T, T_0 and N.

In step 1206, the mobile station B detects a pilot signal of the sync base station C having the highest peak value. Here, the pilot signal enables the mobile station B to estimate the channels and rapidly acquire initial synchronization for new multiple paths.

Besides detection of the pilot signal, in step 1207, the mobile station B analyzes a short sync frame received on the forward short sync channel from the sync base station C to acquire the PN_OFFSET value of the sync base station C. Then, the mobile station B sends a message on the reverse dedicated channel to the async base station A, the message including the PN_OFFSET valueobtained in sep 1207 and the measurement results of the reception strength of the pilot signals from the adjacent base stations. Then, the async base station A reports to the upper network the message received on the reverse dedicated channel from the mobile station B. The upper network ensures the target sync base station C from the report and sends to the async base station A a handoff indication message including information necessary for the handoff. Here, the handoff indication message includes the system information of the target sync base station C and information about the traffic channel for communication with the target base station C, since the mobile station has only the PN_OFFSET value of the sync

base station C received on the short sync channel. Then, if the async base station A received handoff indication message from upper network, the async base station A sends to the mobile station B the handoff direction message including information necessary for handoff in step 1205.

The mobile station B receives the handoff direction message including information about traffic channels for communication with the target sync base station C and the system information of the sync base station C, through the forward dedicated channel from the async base station A. Once receiving the handoff direction message, the mobile station B prepares to receive traffic data from the sync base station C with reference to the traffic channel information and the system information included in the message. In step 1208, the mobile station B receives null traffic data or others on a forward fundamental channel from the sync base station C to ensure stability of channels. The mobile station B receives in step 1209 a traffic message on the forward fundamental channel from the sync base station C while moving to a cell of the target sync base station C, thereby switching a call service from the async base station A to the sync base station C. Thereafter, the mobile station B sends a preamble on a reverse fundamental channel to inform that transmission is successful, in step 1210, and sends a handoff complete message on the reverse fundamental channel to the sync base station C, in step 1211.

The difference between the related art method of Fig. 11 and the present invention of Fig. 12 is the way that the mobile station B acquires the system information of the async base station C.

In the related art method, the mobile station B receives the sync signal frame of the sync base station C for at least 240 ms and interprets the sync signal message included in the sync signal frame. Unlike this method, in the present invention method, the mobile station B acquires only the PN_OFFSET value of the sync base station C on a short sync channel and reports the received PN_OFFSET value to the async base station A, which in turn sends the system information of the sync base station C stores therein or received from the upper network to the mobile station B. This method of the present invention reduces the time required for the mobile station to acquire the system sync information of the target sync base station, thereby securing stability in communication with the async base station.

Accordingly, the present invention causes the base station in the sync mobile communication system to transmit the PN_OFFSET value to the mobile station through a short sync channel and enables the mobile station to acquire information about the adjacent cells in a short time. Also, the present invention enables the mobile station presently in the async mobile communication system to perform a handoff to the sync mobile communication system simply using the PN_OFFSET value acquired through the short sync channel. That is, the mobile station is enabled to acquire information about the cells adjacent to the async mobile communication system in a short time, thus shortening call interruption time between the async mobile communication system and the mobile station.

While the invention has been shown and described with reference to a certain preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

WHAT IS CLAIMED IS:

1. A base station transmitter comprising:

a forward pilot channel generator for generating a pilot signal;

a forward sync channel generator for generating a sync signal;

a forward short sync channel generator for generating a short sync signal including a pseudo-noise (PN) offset value of a base station;

a forward dedicated control channel generator for generating a control message of a dedicated channel;

a forward dedicated fundamental channel generator for generating a voice signal; and

a forward dedicated supplemental channel generator for generating packet data.

2. The base station transmitter as claimed in claim 1, wherein the short sync channel generator comprises:

an encoder for encoding the PN offset value;

a repeater for repeating a symbol from the encoder for a predetermined number of times;

an interleaver for interleaving the output of the repeater;

a signal converter for level-converting the output of the interleaver; and

a multiplier for orthogonally spreading the output of the signal converter by multiplying the output of the signal converter by a specific orthogonal code

3. The base station transmitter as claimed in claim 1, wherein the short sync signal generated by the short sync channel generator has at least one repetition within a period of one PN short code.

4. The base station transmitter as claimed in claim 2, wherein the encoder encodes data comprising the PN offset value accompanied with a cyclic redundancy check (CRC) code.

5. A method for performing a handoff from an async base station to a sync base station when a mobile station travels from a present cell of the async base station to a cell of the sync base station, the method comprising the steps of:

the mobile station's receiving a PN offset signal from the sync base station for a predetermined time, the PN offset signal indicating a specific PN offset value assigned to the sync base station;

reporting the PN offset value to the async base station;

receiving system information about the sync base station from the async base station; and

performing the handoff to the sync base station based on the received system information.

6. The method as claimed in claim 5, wherein the PN offset signal is broadcasted through a forward short sync channel of the sync base station.

7. The method as claimed in claim 6, wherein the PN offset signal is transmitted at least once within a period of one PN short code.

8. A method for performing a handoff from an async base station to a sync base station when a mobile station travels from a present cell of the async base station to a cell of the sync base station, the method comprising the steps of:

the async base station's sending a request message to the mobile station to search for adjacent sync base stations;

receiving a specific PN offset value assigned to the individual sync base stations from the mobile station and reporting the PN offset value to an upper network;

receiving system information about the target sync base station from the upper network; and

sending a handoff direction message including the received system information to the mobile station.

9. The method as claimed in claim 8, wherein the step of sending a request message to the mobile station comprises the steps of:

setting parameters concerning a search time interval, a search time period and the number of times for the mobile station to search for the adjacent sync base stations; and

sending a message including the parameters to the mobile station.

10. A method for performing a handoff from an async base station to a sync base station when a mobile station travels from a present cell of the async base station to a cell of the sync base station, the method comprising the steps of:

the mobile station's detecting pilot signals of sync base stations adjacent to the async base station periodically for a given period of time;

receiving a short sync channel signal from the sync base station whose pilot signal having a peak value is detected in a defined time, the short sync

channel signal indicating a specific PN offset value assigned to the sync base station;

reporting the PN offset value to the async base station;

receiving a handoff direction message including system information of the sync base station from the async base station; and

performing the handoff to the sync base station based on the received system information.

11. The method as claimed in claim 10, wherein the step of performing the handoff comprises the steps of:

receiving null traffic data from the sync base station through a traffic channel with reference to the traffic channel information included in the system information; and

sending a preamble signal through a reverse fundamental channel and then a handoff complete message to target sync base station upon determining that the null traffic data is successfully received.

12. The method as claimed in claim 10, wherein the mobile station temporarily stores signals from the adjacent sync base stations for the given period of time and detects the pilot signals of the adjacent sync base stations with the stored signals.

13. A method for performing a handoff from an async base station to a sync base station when a mobile station travels from a present cell of the async base station to a cell of the sync base station, the method comprising the steps of:

the async base station's sending a request message to the mobile station to search for adjacent sync base station;

the mobile station's searching for the adjacent sync base stations periodically for a given period of time by async base station's request;

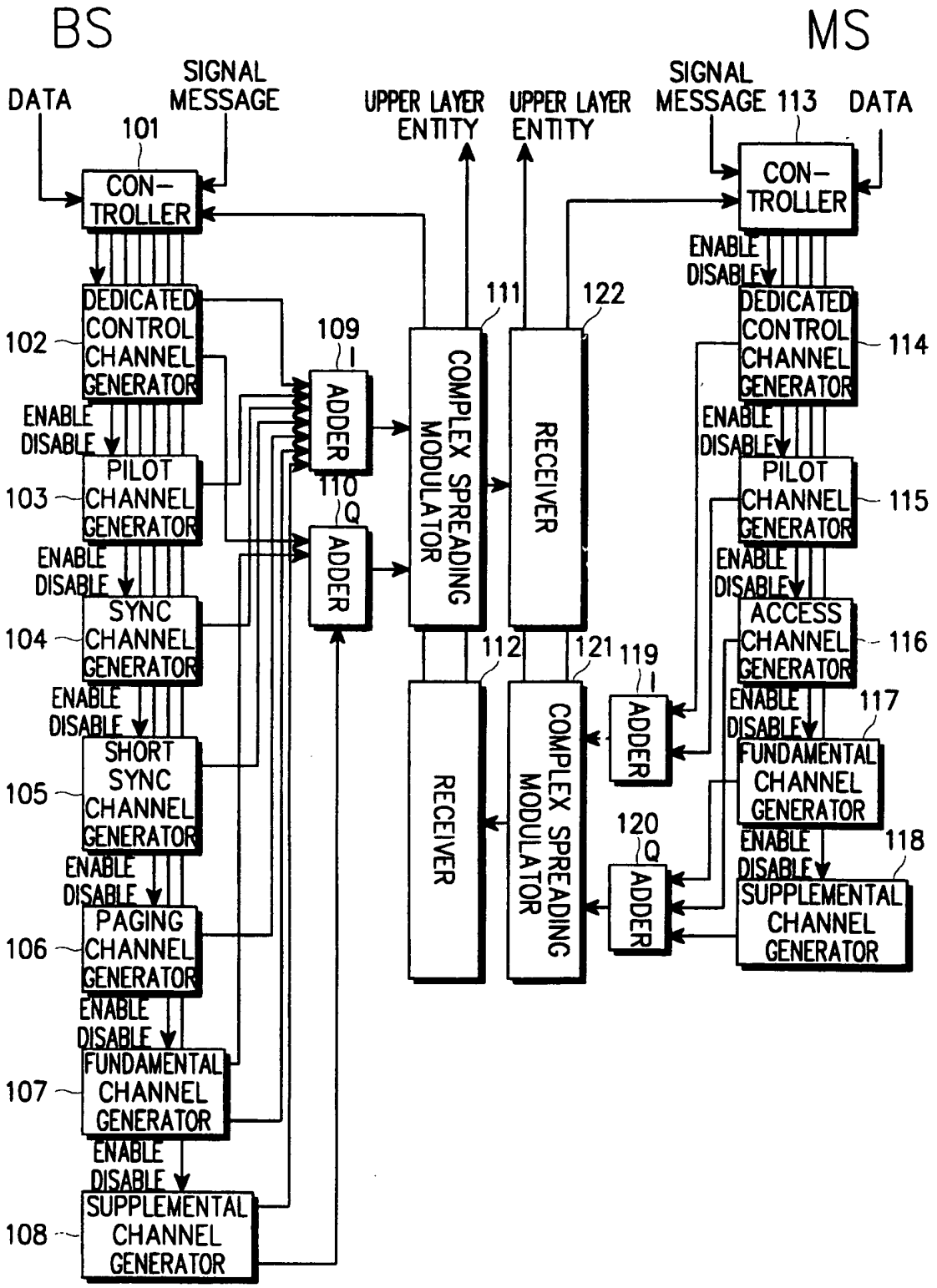
the mobile station's receiving a short sync channel signal from the target sync base station while searching for the adjacent sync base stations, the short sync channel signal indicating a specific PN offset value assigned to the sync base station, and reporting the PN offset value to the async base station;

the async base station's reporting the PN offset value to an upper network, receiving system information about the sync base station from the upper network, and sending a handoff direction message including the system information to the mobile station; and

the mobile station's performing the handoff to the sync base station based

on the received system information.

14. The method as claimed in claim 13, wherein the request message includes parameters concerning a search time interval, a search time period and the number of times for the mobile station to search for the adjacent sync base stations.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ENABLE DISABLE
DEDICATED CONTROL CHANNEL GENERATOR
102
PILOT CHANNEL GENERATOR
103
SYNC CHANNEL GENERATOR
104
SHORT SYNC CHANNEL GENERATOR
105
PAGING CHANNEL GENERATOR
106
FUNDAMENTAL CHANNEL GENERATOR
107
SUPPLEMENTAL CHANNEL GENERATOR
108
109 I
110 Q
ADDER
ADDER
COMPLEX SPREADING MODULATOR
111
RECEIVER
122
RECEIVER
112
COMPLEX SPREADING MODULATOR
121
119 I
120 Q
ADDER
ADDER
DEDICATED CONTROL CHANNEL GENERATOR
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FUNDAMENTAL CHANNEL GENERATOR
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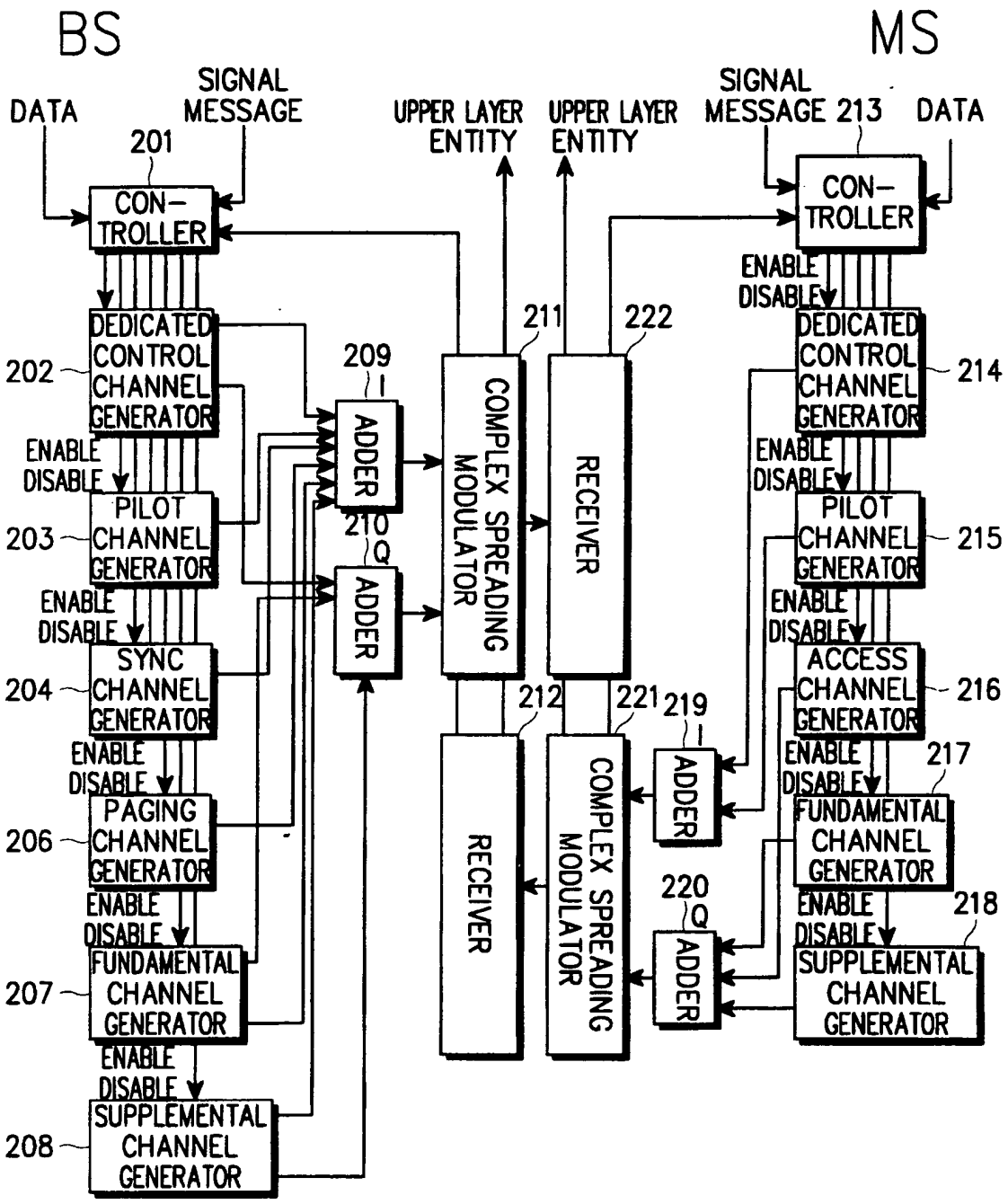
SUPPLEMENTAL CHANNEL GENERATOR

FIG. 1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DEDICATED CONTROL CHANNEL GENERATOR
202
209 I
ADDER
211
COMPLEX SPREADING MODULATOR
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215
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SYNC CHANNEL GENERATOR
204
212
221
219 I
ACCESS CHANNEL GENERATOR
216
ENABLE DISABLE
PAGING CHANNEL GENERATOR
206
RECEIVER
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ENABLE DISABLE
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SUPPLEMENTAL CHANNEL GENERATOR

FIG. 2

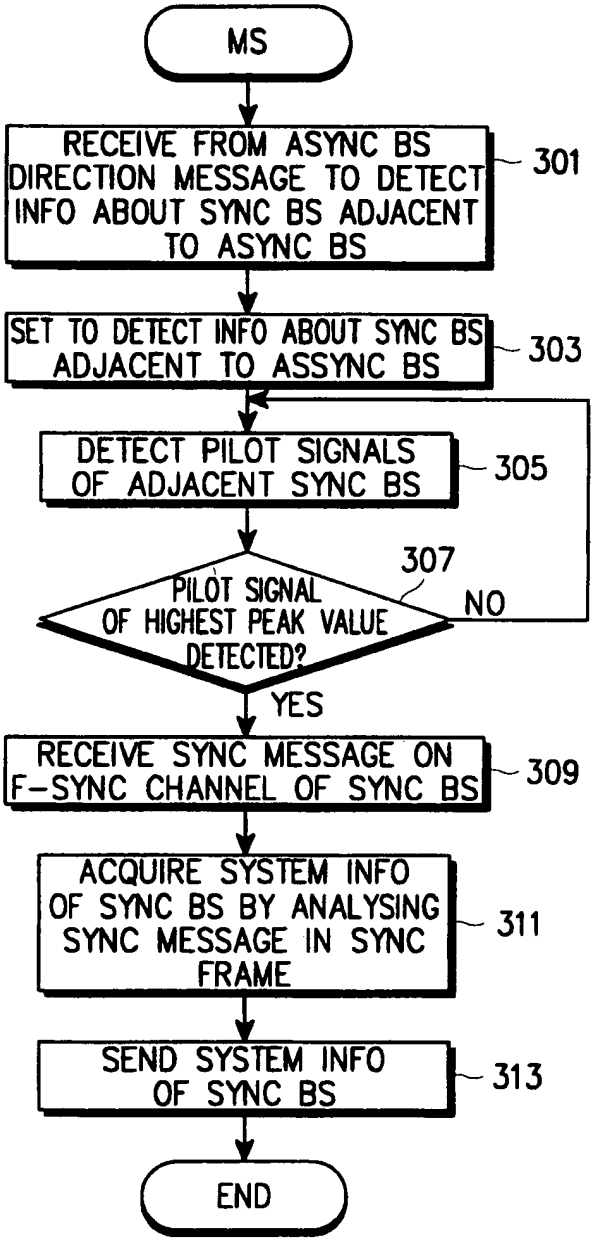

MS
RECEIVE FROM ASYNC BS DIRECTION MESSAGE TO DETECT INFO ABOUT SYNC BS ADJACENT TO ASYNC BS
301
SET TO DETECT INFO ABOUT SYNC BS ADJACENT TO ASSYNC BS
303
DETECT PILOT SIGNALS OF ADJACENT SYNC BS
305
307
PILOT SIGNAL OF HIGHEST PEAK VALUE DETECTED?
NO
YES
RECEIVE SYNC MESSAGE ON F-SYNC CHANNEL OF SYNC BS
309
ACQUIRE SYSTEM INFO OF SYNC BS BY ANALYSING SYNC MESSAGE IN SYNC FRAME
311
SEND SYSTEM INFO OF SYNC BS
313
END

FIG. 3

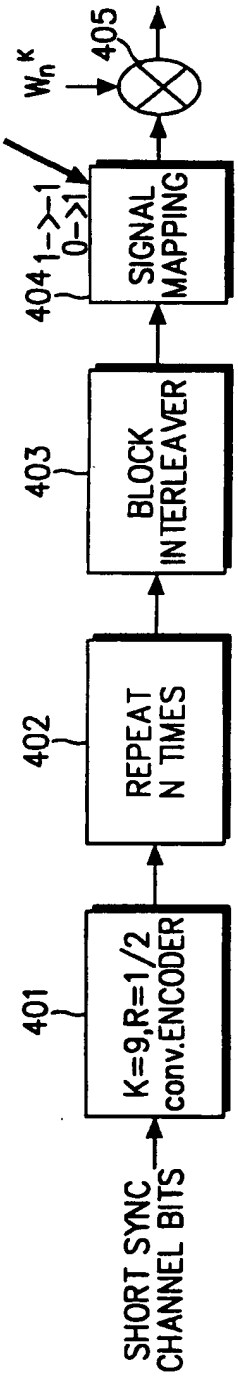

SHORT SYNC CHANNEL BITS
401
K=9,R=1/2 conv.ENCODER
402
REPEAT N TIMES
403
BLOCK INTERLEAVER
404
1->-1 0->1
SIGNAL MAPPING
405
W_n^k

FIG. 4

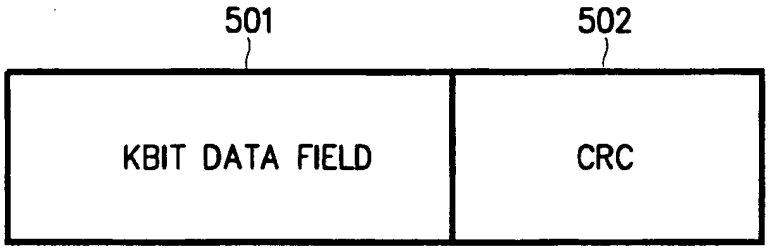


FIG. 5

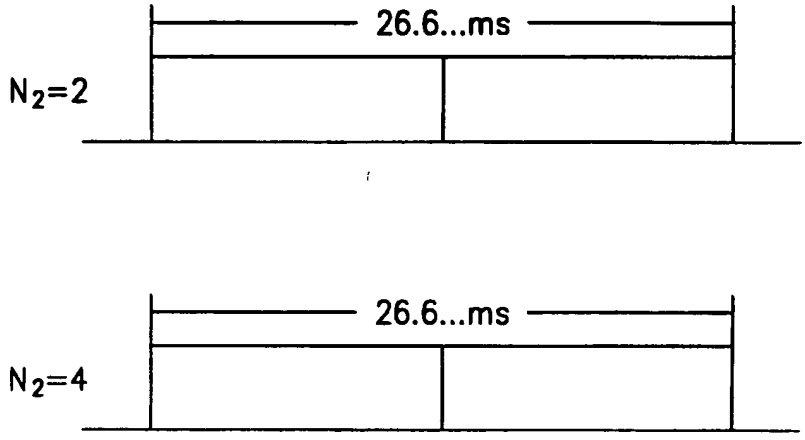


FIG. 6

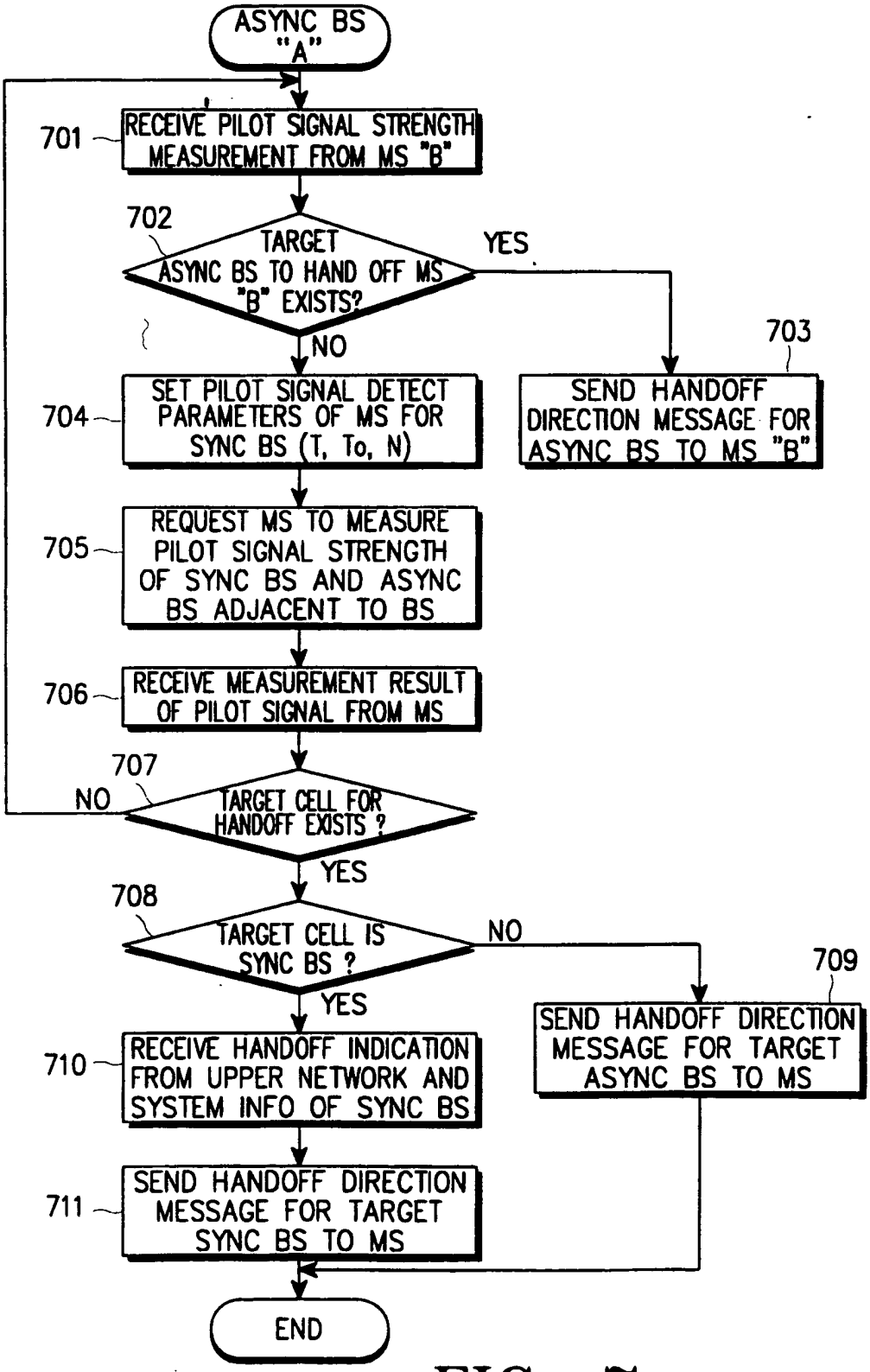

ASYNC BS "A"
701
RECEIVE PILOT SIGNAL STRENGTH MEASUREMENT FROM MS "B"
702
TARGET ASYNC BS TO HAND OFF MS "B" EXISTS?
YES
NO
703
SEND HANDOFF DIRECTION MESSAGE FOR ASYNC BS TO MS "B"
704
SET PILOT SIGNAL DETECT PARAMETERS OF MS FOR SYNC BS (T, To, N)
705
REQUEST MS TO MEASURE PILOT SIGNAL STRENGTH OF SYNC BS AND ASYNC BS ADJACENT TO BS
706
RECEIVE MEASUREMENT RESULT OF PILOT SIGNAL FROM MS
707
NO
TARGET CELL FOR HANDOFF EXISTS ?
YES
708
TARGET CELL IS SYNC BS ?
NO
709
SEND HANDOFF DIRECTION MESSAGE FOR TARGET ASYNC BS TO MS
YES
710
RECEIVE HANDOFF INDICATION FROM UPPER NETWORK AND SYSTEM INFO OF SYNC BS
711
SEND HANDOFF DIRECTION MESSAGE FOR TARGET SYNC BS TO MS
END

FIG. 7

FIG. 8A

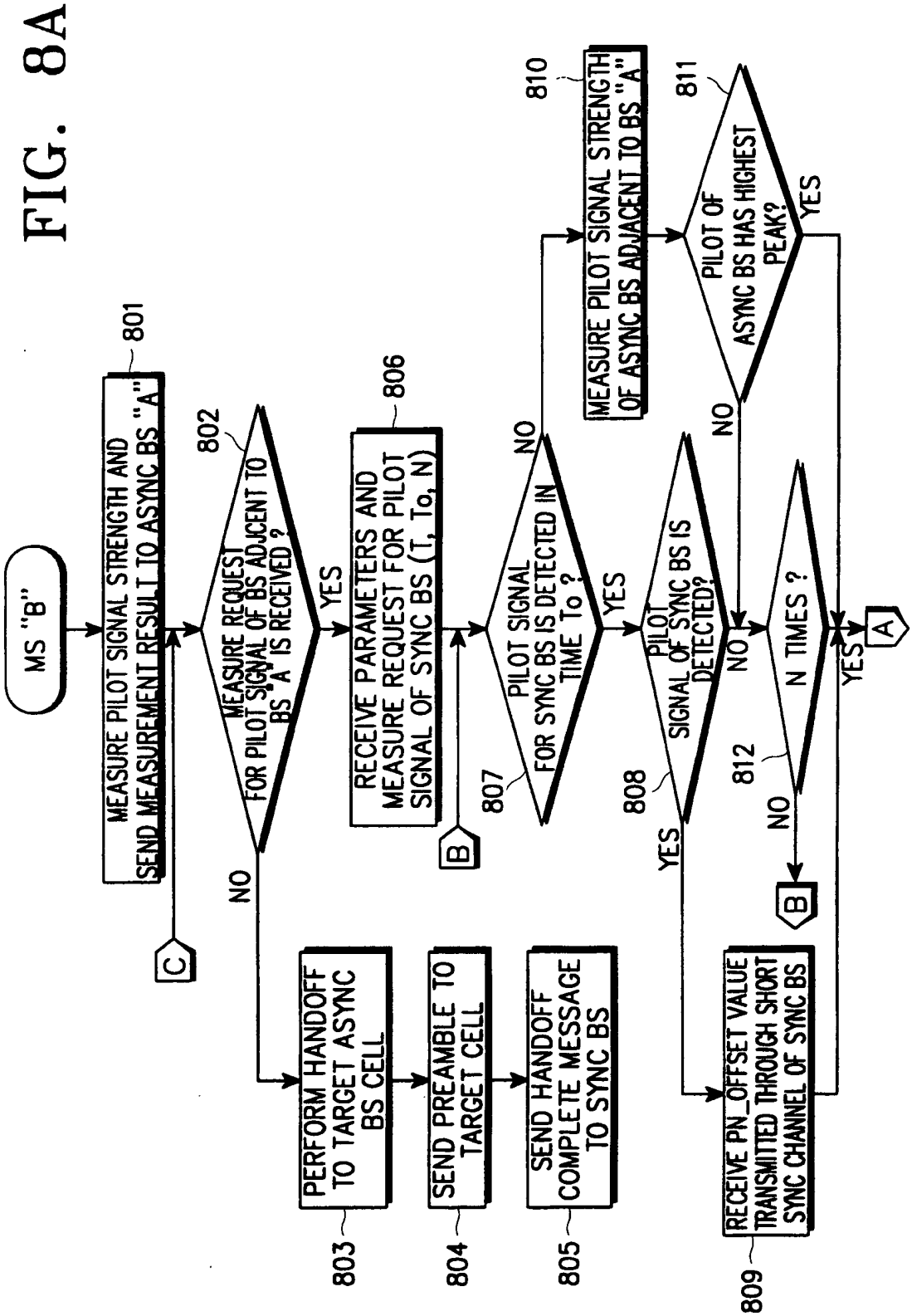
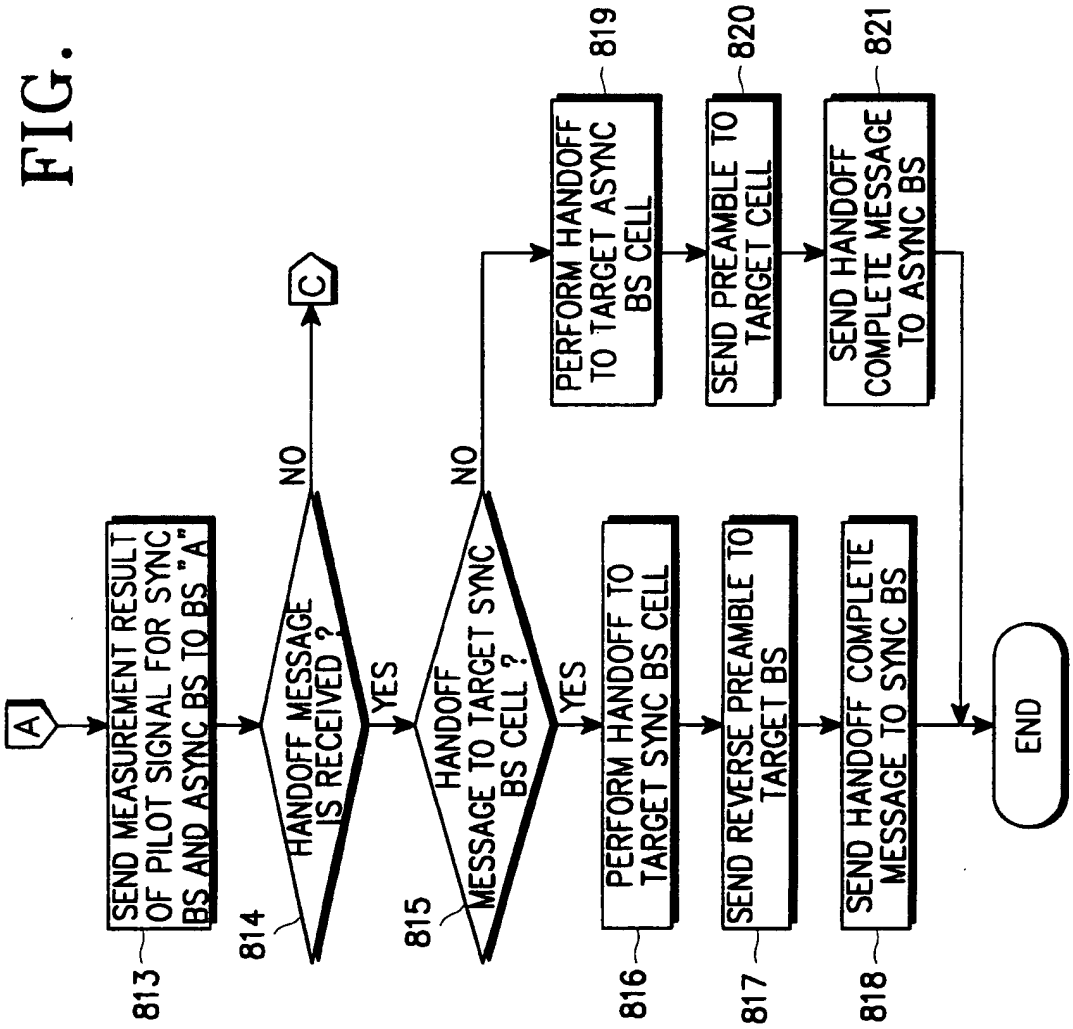

MS "B"
MEASURE PILOT SIGNAL STRENGTH AND SEND MEASUREMENT RESULT TO ASYNC BS "A"
801
MEASURE REQUEST FOR PILOT SIGNAL OF BS ADJACENT TO BS "A" IS RECEIVED ?
802
YES
NO
RECEIVE PARAMETERS AND MEASURE REQUEST FOR PILOT SIGNAL OF SYNC BS (T, To, N)
806
PILOT SIGNAL FOR SYNC BS IS DETECTED IN TIME To ?
807
NO
YES
MEASURE PILOT SIGNAL STRENGTH OF ASYNC BS ADJACENT TO BS "A"
810
PILOT SIGNAL OF SYNC BS IS DETECTED?
808
YES
NO
PILOT OF ASYNC BS HAS HIGHEST PEAK?
811
YES
NO
N TIMES ?
812
YES
NO
PERFORM HANDOFF TO TARGET ASYNC BS CELL
803
SEND PREAMBLE TO TARGET CELL
804
SEND HANDOFF COMPLETE MESSAGE TO SYNC BS
805
RECEIVE PN_OFFSET VALUE TRANSMITTED THROUGH SHORT SYNC CHANNEL OF SYNC BS
809
A
B
B
C

FIG. 8B


A
SEND MEASUREMENT RESULT OF PILOT SIGNAL FOR SYNC BS AND ASYNC BS TO BS "A"
813
HANDOFF MESSAGE IS RECEIVED ?
814
NO
C
YES
HANDOFF MESSAGE TO TARGET SYNC BS CELL ?
815
NO
YES
PERFORM HANDOFF TO TARGET SYNC BS CELL
816
SEND REVERSE PREAMBLE TO TARGET BS
817
SEND HANDOFF COMPLETE MESSAGE TO SYNC BS
818
PERFORM HANDOFF TO TARGET ASYNC BS CELL
819
SEND PREAMBLE TO TARGET CELL
820
SEND HANDOFF COMPLETE MESSAGE TO ASYNC BS
821
END

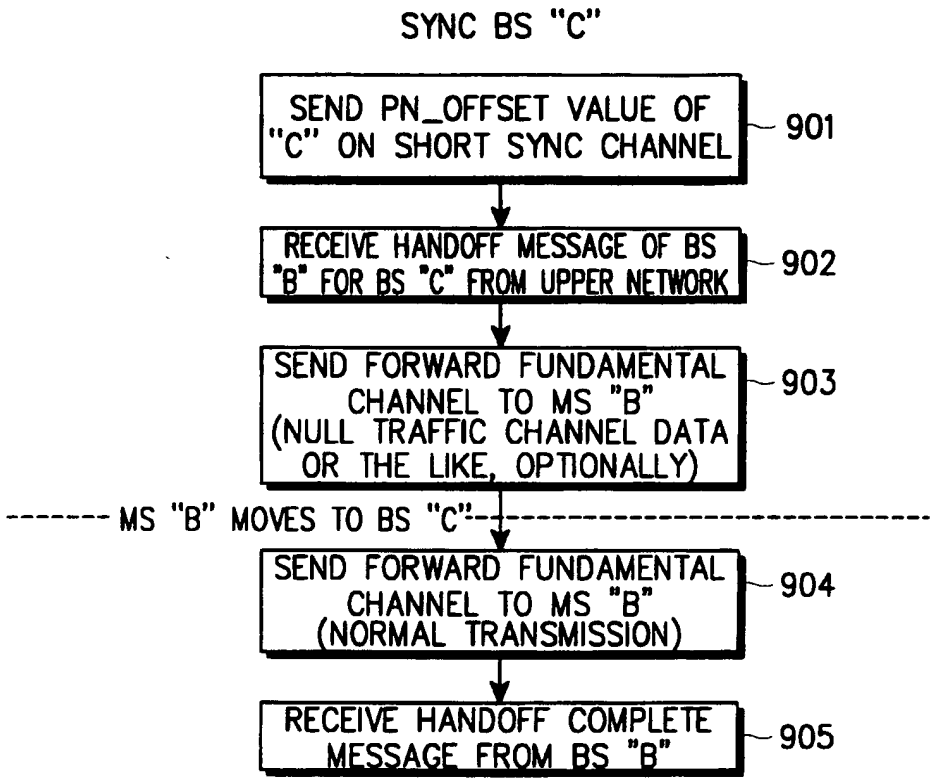

SYNC BS "C"
SEND PN_OFFSET VALUE OF "C" ON SHORT SYNC CHANNEL
901
RECEIVE HANDOFF MESSAGE OF BS "B" FOR BS "C" FROM UPPER NETWORK
902
SEND FORWARD FUNDAMENTAL CHANNEL TO MS "B" (NULL TRAFFIC CHANNEL DATA OR THE LIKE, OPTIONALLY)
903
MS "B" MOVES TO BS "C"
SEND FORWARD FUNDAMENTAL CHANNEL TO MS "B" (NORMAL TRANSMISSION)
904
RECEIVE HANDOFF COMPLETE MESSAGE FROM BS "B"
905

FIG. 9

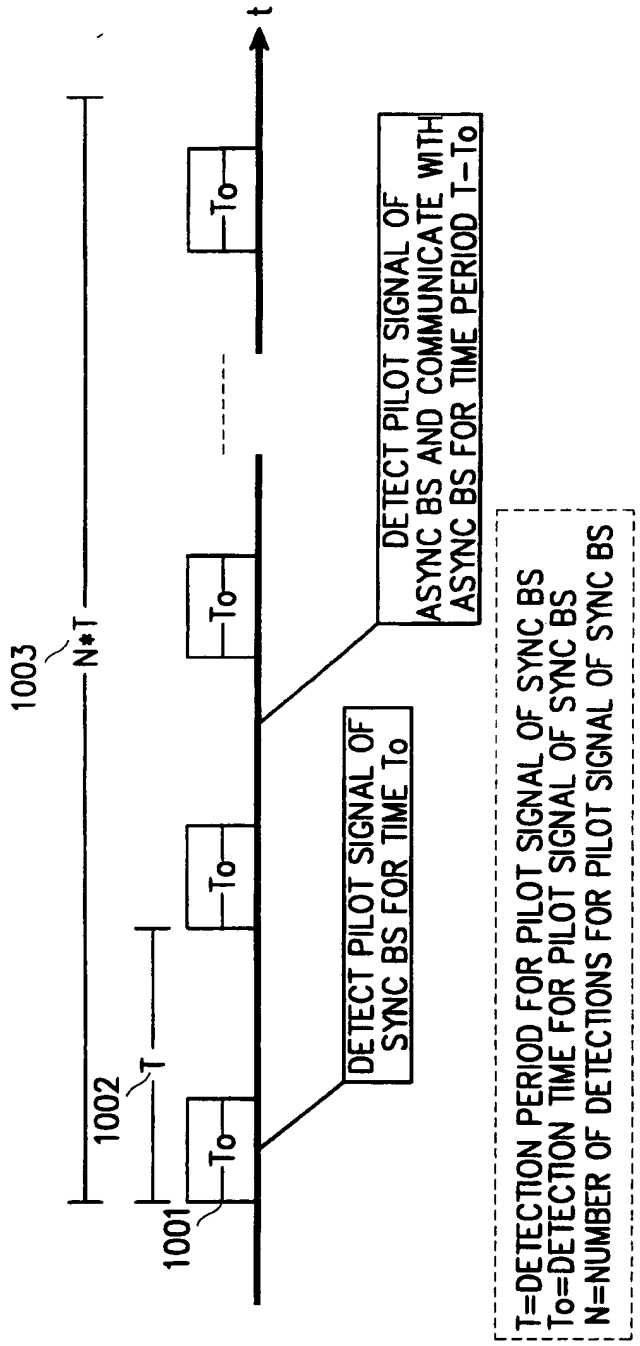

t
1003
N*T
1002
T
1001
To
To
To
To
DETECT PILOT SIGNAL OF SYNC BS FOR TIME To
DETECT PILOT SIGNAL OF ASYNC BS AND COMMUNICATE WITH ASYNC BS FOR TIME PERIOD T-To
T=DETECTION PERIOD FOR PILOT SIGNAL OF SYNC BS
To=DETECTION TIME FOR PILOT SIGNAL OF SYNC BS
N=NUMBER OF DETECTIONS FOR PILOT SIGNAL OF SYNC BS

FIG. 10

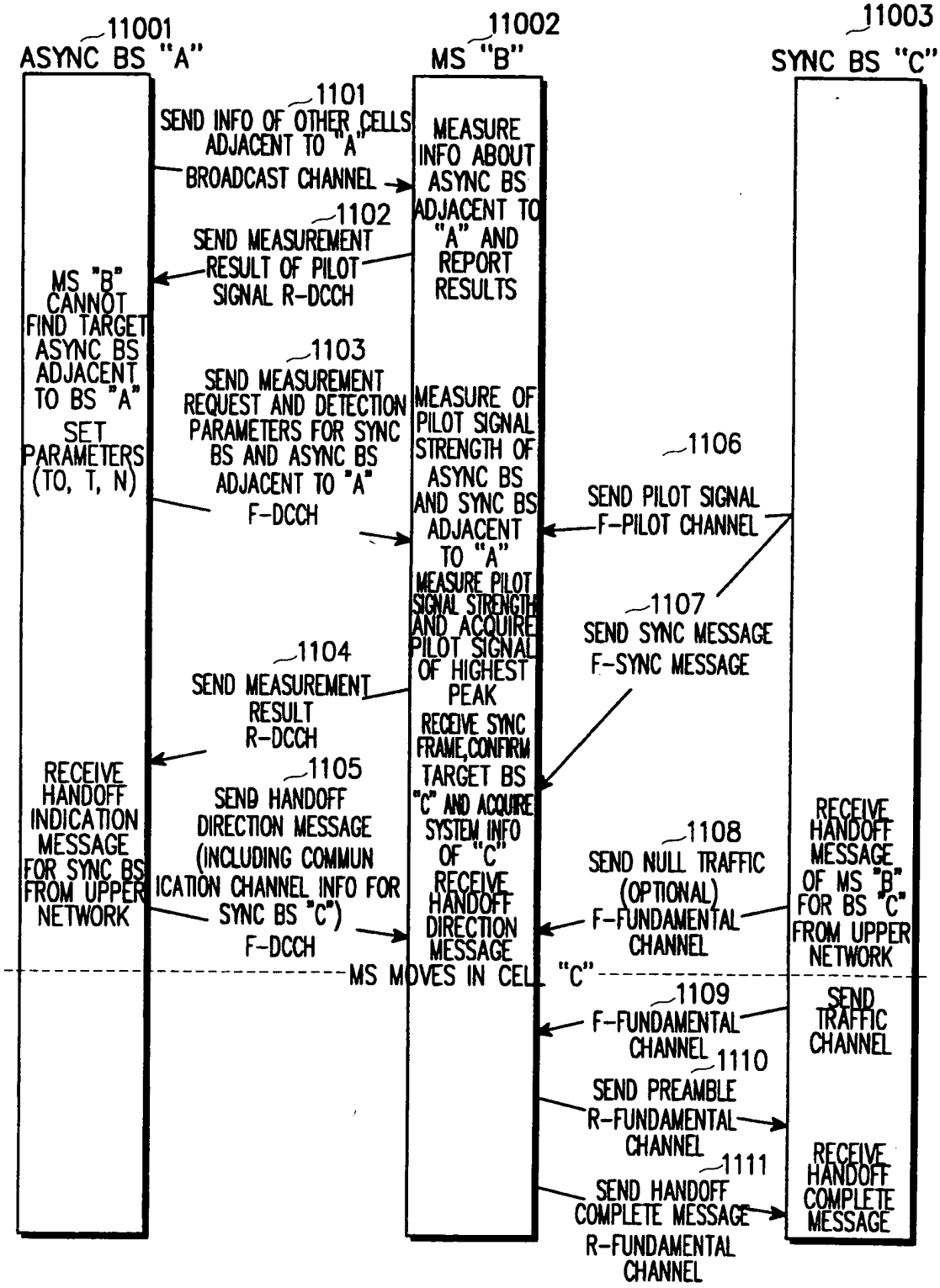

11001
ASYNC BS "A"
11002
MS "B"
11003
SYNC BS "C"
1101
SEND INFO OF OTHER CELLS ADJACENT TO "A"
BROADCAST CHANNEL
MEASURE INFO ABOUT ASYNC BS ADJACENT TO "A" AND REPORT RESULTS
1102
SEND MEASUREMENT RESULT OF PILOT SIGNAL R-DCCH
MS "B" CANNOT FIND TARGET ASYNC BS ADJACENT TO BS "A"
SET PARAMETERS (TO, T, N)
1103
SEND MEASUREMENT REQUEST AND DETECTION PARAMETERS FOR SYNC BS AND ASYNC BS ADJACENT TO "A"
F-DCCH
MEASURE OF PILOT SIGNAL STRENGTH OF ASYNC BS AND SYNC BS ADJACENT TO "A"
1106
SEND PILOT SIGNAL
F-PILOT CHANNEL
MEASURE PILOT SIGNAL STRENGTH AND ACQUIRE PILOT SIGNAL OF HIGHEST PEAK
1107
SEND SYNC MESSAGE
F-SYNC MESSAGE
1104
SEND MEASUREMENT RESULT
R-DCCH
RECEIVE SYNC FRAME, CONFIRM TARGET BS "C" AND ACQUIRE SYSTEM INFO OF "C"
RECEIVE HANDOFF INDICATION MESSAGE FOR SYNC BS FROM UPPER NETWORK
1105
SEND HANDOFF DIRECTION MESSAGE (INCLUDING COMMUNICATION CHANNEL INFO FOR SYNC BS "C")
F-DCCH
1108
SEND NULL TRAFFIC (OPTIONAL)
F-FUNDAMENTAL CHANNEL
RECEIVE HANDOFF MESSAGE OF MS "B" FOR BS "C" FROM UPPER NETWORK
RECEIVE HANDOFF DIRECTION MESSAGE
MS MOVES IN CELL "C"
1109
F-FUNDAMENTAL CHANNEL
SEND TRAFFIC CHANNEL
1110
SEND PREAMBLE
R-FUNDAMENTAL CHANNEL
1111
SEND HANDOFF COMPLETE MESSAGE
R-FUNDAMENTAL CHANNEL
RECEIVE HANDOFF COMPLETE MESSAGE

FIG. 11

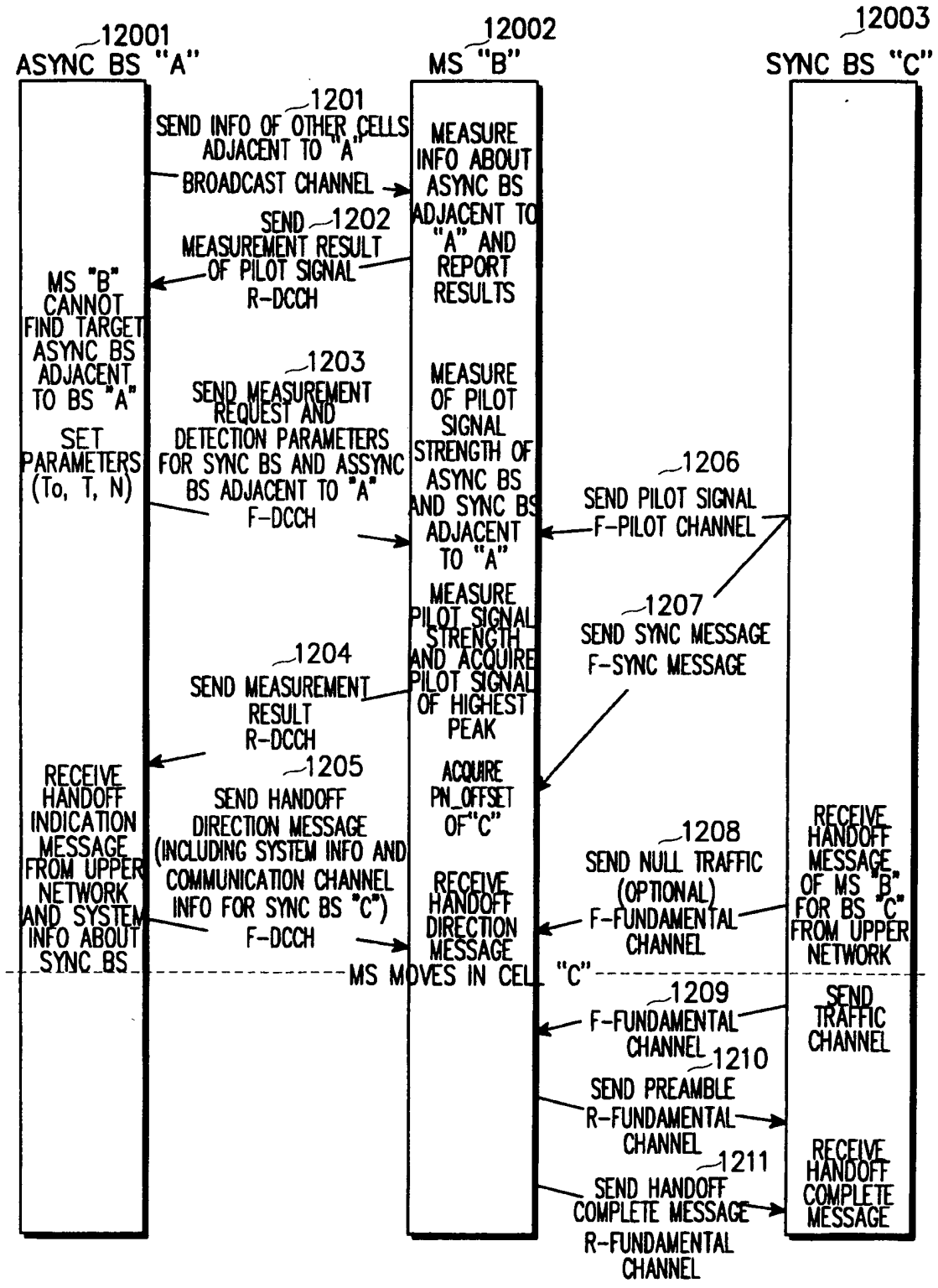

12001
ASYNC BS "A"
12002
MS "B"
12003
SYNC BS "C"
1201
SEND INFO OF OTHER CELLS ADJACENT TO "A"
BROADCAST CHANNEL
MEASURE INFO ABOUT ASYNC BS ADJACENT TO "A" AND REPORT RESULTS
1202
SEND MEASUREMENT RESULT OF PILOT SIGNAL
R-DCCH
MS "B" CANNOT FIND TARGET ASYNC BS ADJACENT TO BS "A"
SET PARAMETERS (To, T, N)
1203
SEND MEASUREMENT REQUEST AND DETECTION PARAMETERS FOR SYNC BS AND ASSYNC BS ADJACENT TO "A"
F-DCCH
MEASURE OF PILOT SIGNAL STRENGTH OF ASYNC BS AND SYNC BS ADJACENT TO "A"
1206
SEND PILOT SIGNAL
F-PILOT CHANNEL
MEASURE PILOT SIGNAL STRENGTH AND ACQUIRE PILOT SIGNAL OF HIGHEST PEAK
1207
SEND SYNC MESSAGE
F-SYNC MESSAGE
1204
SEND MEASUREMENT RESULT
R-DCCH
1205
SEND HANDOFF DIRECTION MESSAGE (INCLUDING SYSTEM INFO AND COMMUNICATION CHANNEL INFO FOR SYNC BS "C")
F-DCCH
ACQUIRE PN_OFFSET OF "C"
RECEIVE HANDOFF DIRECTION MESSAGE
1208
SEND NULL TRAFFIC (OPTIONAL)
F-FUNDAMENTAL CHANNEL
RECEIVE HANDOFF MESSAGE OF MS "B" FOR BS "C" FROM UPPER NETWORK
RECEIVE HANDOFF INDICATION MESSAGE FROM UPPER NETWORK AND SYSTEM INFO ABOUT SYNC BS
MS MOVES IN CELL "C"
1209
F-FUNDAMENTAL CHANNEL
SEND TRAFFIC CHANNEL
1210
SEND PREAMBLE
R-FUNDAMENTAL CHANNEL
1211
SEND HANDOFF COMPLETE MESSAGE
R-FUNDAMENTAL CHANNEL
RECEIVE HANDOFF COMPLETE MESSAGE

FIG. 12

INTERNATIONAL SEARCH REPORT

international application No.
PCT/KR00/00568

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H04B 7/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimun documentation searched (classification system followed by classification symbols)

IPC7 H04B, H04Q 7/22, H04Q 7/38

Documentation searched other than minimun documentation to the extent that such documents are included in the fileds searched

Korean Patents and applications for inventions since 1975
Korean Utility models and applications for Utility models since 1975

Electronic data base consulted during the internationl search (name of data base and, where practicable, search trerms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, A	KR 99-76438 A (SAMSUNG CORP.) 15 October 1999 see the whole document	1 - 14
A	KR 98-703494 A (QUALCOMM INC.) 05 November 1998 see the abstract, claims	1 - 14
A	WO 97-31503 A (QUALCOMM INC.) 28 August 1997 see the abstract, claims	1 - 14

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 SEPTEMBER 2000 (22.09.2000)	25 SEPTEMBER 2000 (25.09.2000)

Name and mailing address of the ISA/KR	Authorized officer
Korean Industrial Property Office Government Complex-Taejon, Dunsan-dong, So-ku, Taejon Metropolitan City 302-701, Republic of Korea Facsimile No. 82-42-472-7140	YOON, Byoung Soo Telephone No. 82-42-481-5709

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR00/00568

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 99-76438 A	15.10.1999	WO 9950977 A	07.10.1999
		EP 0986866 A	22.03.2000
KR 98-703494 A	05.11.1998	WO 9631078 A	03.10.1996
		US 5594718 A	14.01.1997
		EP 0818117 A	14.01.1998
WO 97-31503 A	28.08.1997	US 5978679 A	02.11.1999
		JP 0505261 T2	25.04.2000
		EP 0882378 A	09.12.1998

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